Beryllium Surface Cleaning Process

For more information contact **Thomas M. Vercelli**
(925) 423-4759, vercelli2@llnl.gov

LLNL health and safety procedures require that Be parts, and machine parts such as tooling, which have come in contact with Be, be cleaned to a level of 0.2 μm gm/100 cm^2 or less for free release to non-Be work areas. Currently no agreed-upon procedures exist for this cleaning. A standardized cleaning process for Be parts with a documented cleaning efficiency can establish a Be part as an article, with out sampling each part.

An ultrasonic cleaning process (Fig. 1) using a water-based detergent appeared to be a good candidate to evaluate for use at LLNL. A documented and agreed-upon cleaning process used by other DOE Contractors would minimize concern when accepting their Be parts. An appropriate statistical analysis would permit periodic or spot-checking of cleanliness levels, rather than evaluating every piece.

Project Goals

The goals of this project are: first, to evaluate the potential of an ultrasonic cleaning process as a DOE standard for cleaning of Be parts, with an efficiency that establishes a Be part as an article; and second, to investigate the availability and cost of a commercial ultrasonic cleaning unit to be integrated into LLNL's Be facility.

Relevance to LLNL Mission

This project supports Integrated Safety Management principles. If successful,

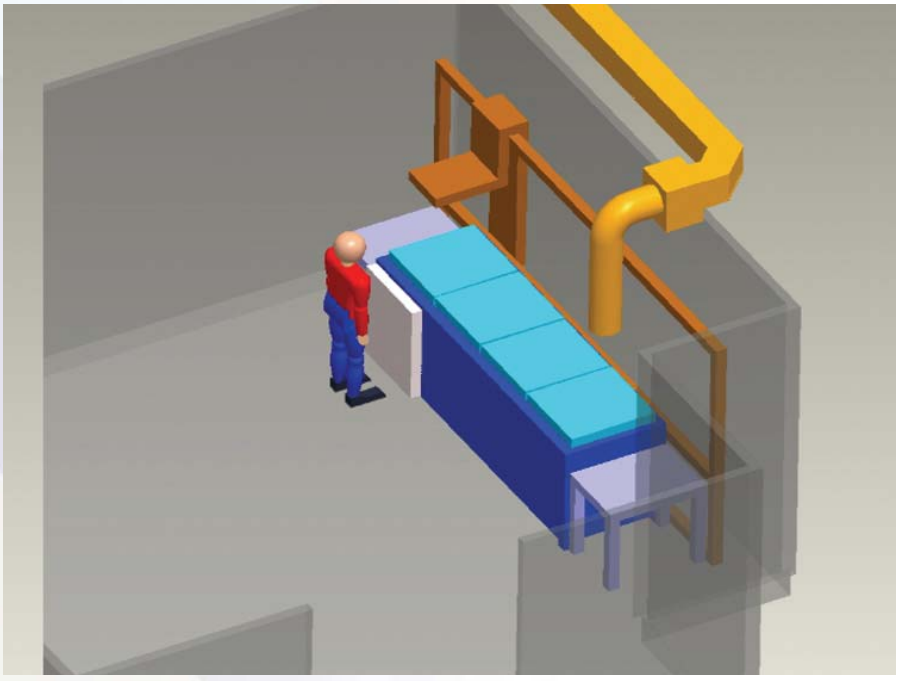

Figure 1. Concept of an ultrasonic cleaning system in LLNL's Be Facility.

Figure 2. Two views of the Colster-3 ultrasonic cleaning tank.

worker safety will be improved, and Be parts will be handled in a more safe and expedient manner. Some LLNL beneficiaries of this project are Hazards Control, DNT, and NIF

FY2004 Accomplishments and Results

During this project a Colster-3 benchtop ultrasonic cleaning unit (Fig. 2) was modified to provide local ventilation and re-circulation/filtration of rinse water. The ventilation was integrated into the HEPA filtration system.

Jem Chemical Co., #68XLF water-based cleaning detergent was purchased for the initial evaluation. Nine Be test pieces, approximately 6 in. × 2 in. × .25 in., were cut and machined. A swipe was taken from half of the area of each side of the test sample before and after cleaning. Each test part was individually put into the cleaning bath for 15 min. The cleaning agent was maintained at 130 °F. After cleaning, the part was placed into the rinse tank for 15 min, and then into the dryer tank for 15 min. The process was repeated for all nine test parts. Swipes taken after the cleaning cycle revealed that, while the Be parts showed improvement, they still contained removable Be particles above free-release limits of 0.2 μm gm/100 cm^2.

The test parts were re-swiped and put through a second cleaning cycle, with little to no improvement in removal of Be particles.

A cleaning experiment using "shaped" test parts was also conducted. Be parts were machined with features such as slots, through-holes, and tapped holes. The shaped parts were put through the same cleaning process as the first nine test parts. Swipe results found Be particles above free-release limits. The highest values recorded were in the threaded holes.

An additional series of tests planned to vary parameters that may improve the cleaning efficiency is needed before any decision on the scale-up of this process can be made for application in the Be facility.

A study of outside (industrial) Be cleaning processes revealed that the requirements for Be contamination control in industry are not well defined and are typically ignored. Those that perform cleaning of Be manufactured items use standard degreasing techniques, with a small number using ultrasonic cleaning methods. The Be Control Program at LANL calls for large-scale ultrasonic cleaning systems in their Be Facility but they do not attempt to reach the free-release threshold.

Large-scale commercial ultrasonic cleaning systems typically have tank sizes of 30 in. × 30 in. × 30 in. Systems differ by number and location of the frequency transducers, heater capacity, automation options, ventilation systems, and size. Both systems we evaluated used a 40-kHz ultrasonic frequency and a filter system for the cleaning agent. One unit offered other frequencies, depending on the cleaning application. Both systems would require integration into the Be facility. This involves a HEPA ventilation system, a retention tank for proper disposal of the cleaning and rinse water solutions, a de-ionized rinse water make-up system, and electrical power.